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POTENTIAL OF SAGO EFFLUENT FOR AGRICULTURAL USE

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ABSTRACT

Cassava industry is one of the major water consuming and polluting agro based industries prevalent in parts of Tamil Nadu and Andhra Pradesh in India. With the growing demands and decimation of resources, scarcity of fresh waters made it necessary to consider conversion of waste waters for reuse as an additional resource **(AquaFed, 2013),** which in turn lower the burden of pollution load. The main objective of this study is to explore the possibilities for the potential use of Sago effluent in Agriculture. With this backdrop, the present work has studied the quality of the Sago effluent and its impacts on some important agricultural crops. The paper has studied the Physico-chemical analysis of sago waste water and the impacts of sago effluent on some *leguminacea* crops; *Phaselous mungo* (Blackgram), *Cajanus cajana* (redgram), *Phaselous aureus* (Green gram).The studies include germination percentage, seedling growth and dry weight. Physico chemical characters of cassava sago effluent were studied for two types of industries; *old* and *uptech*. At low concentrations sago waste water enhanced the growth while higher concentrations reduced the growth. This suggests that lower concentration of sago industry effluent has the potential for agricultural use after appropriate treatment.

KEYWORDS: Cassava, Sago Effluent and Agricultural Use

INTRODUCTION

The expansion of Indian industry has increasingly facilitated the generation of industrial effluents and various processes are being employed to manage these effluents. Majority of the Waste waters are of obnoxious odour, irritating in colour, acidic in nature and contains high BOD and COD. The untreated effluents affect the health of the soil, natural ecosystems, plants, animals, and human beings, **(Ayyasamy, et al, 2002 and Rubanet al, 2013)**. Fermentation of the residues can cause the generation of CO_2, acetic and lactic acids which contribute to strong odours (**Bradbury, 2006; Horsfall, *et al*, 2006, Cumbana, *et al.*, 2007).** Though many conventional methods are available for management of theses effluents, Irrigation is considered as a better management option since it is an economically viable and environmentally compatible low cost technology. Majority of these effluents contain essential nutrients like Nitrogen, Phosphorous and Potassium required for plant nutrition in substantial quantities, hence the waste water can find application as irrigation water in Agriculture. Though this practice is in vogue for many years, seldom the implications of the use of these effluents in Agriculture are evaluated before it is practiced in the field. Hence, the evaluation of the performance of these effluents on different facets of Agro operations is necessary. The present work is a systematic attempt in this direction and reports the impact of Sago industry effluents on some *leguminacea* crops, which are grown widely in the study area. The crops include *Phaselous mungo* (Black gram), *Cajanus cajan* (red gram), *Phaselous aureus* (Green gram) and. The parameters studied include germination success, and dry weight of seedlings.

MATERIALS AND METHODS

Study Area: Samalkot of East Godavari district in Andhra Pradesh is one of the centers in India where large-scale production and processing of Tapioca is carried out. Nearly 50,000 *acres* of land is under Tapioca cultivation providing employment to nearly 15000 *people* directly and indirectly. The present study was carried out in Samalkot Sago cluster.

Seed Material: The seed material of *Phaselous mungo* (Black gram), *Cajanus cajan* (Red gram), *Phaselous aureus* (Green gram) was procured from a local reputed Agricultural marketing society in Kakinada.

Waste Water: Adequate amount of Sago wastewater was collected (**Rao & Rao, 2002**)in plastic jars from primary, secondary and combined waste water tanks of uptech and old industries located in the study area at specified times. pH of the samples was recorded during collection of the samples. The samples were taken to Andhra University Environmental Sciences Laboratory in Visakhapatnam City for further analysis. Standard methods (**APHA, 1998**) were employed for analyzing physico-chemical parameters of the waste water. Analytical grade reagents and deionised distilled water was employed throughout the study.

Germination: Germination experiments were carried out in sterilized petridishes (**Sreya Basu, 2008**). 25 seeds from each cultivar were taken in sterilized petridishes (15x12 *cm*) at uniform distance for each treatment. These seeds were treated with equal doses of different concentrations (v/v) of wastewater (0%, 2%, 5%, 10%, 20%, and 30%) as and when necessary. Seeds treated with distilled water were maintained as control. The petridishes were kept under diffused light at room temperature (30 $\pm 1.0^0$C). Emergence of radical having at least 5 *mm* length was taken as an indication of germination. Percent germination was recorded on day 6 and one-week seedlings were used for measurement of seedling growth (Root/shoot).

Vigour index was calculated by using the following formula (**Abdul Baki and Anderson, 1973**)

Vigour Index = Germination percentage x Seedling length

Table 1: Characteristics of Effluents from Old Factory

S. No	Parameter	Root Wash Tank	Primary Settling Tank	Secondary Settling Tank	Combined Waste Water
1.	pH	6.2	4.3	4.6	4.4
2.	TS	820	3300	3400	3200
3.	TSS	530	1550	1500	650
4.	TDS	250	2700	1800	2500
5.	BOD	75	2400	2100	2300
6.	COD	125	3600	3200	2700
7.	Total N_2	65	60	60	70
8.	Total PO_4	1.2	5.1	5.2	1.1
9.	Total hardness	125	130	120	130
10.	Total alkalinity	85	80	85	80

All Values expressed in mg/l except pH.

Abbreviations: DO, Dissolved Oxygen; **COD**, Chemical Oxygen Demand; **BOD**, Biological Oxygen Demand; **TS**, Total Solids; **TSS**, Total Suspended Solid; and **TDS**, Total Dissolved Solids.

Table 2: Characteristics of Effluents from an Uptech Factory

S. No	Parameter	Root Wash Tank	Primary Settling Tank	Secondary Settling Tank	Combined Waste Water
1.	pH	6.5	4.5	4.9	5.0
2.	T.S	620	2700	3100	2900
3.	T.S.S	425	475	1100	525
4.	T.D.S	185	2200	1500	1750
5.	B. O. D	60	2000	1800	2000
6.	C. O. D	80	3100	2600	2800
7.	Total N_2	70	60	65	50
8.	Total PO_4	1.5	5.1	6.6	6.6
9.	Total hardness	120	120	90	85
10.	Total alkalinity	70	70	60	120

All Values expressed in mg/l except pH.

Abbreviations: DO, Dissolved Oxygen; **COD**, Chemical Oxygen Demand; **BOD**, Biological Oxygen Demand; **TS**, Total Solids; **TSS**, Total Suspended Solid; and **TDS**, Total Dissolved Solids.

Table 3: Effect of Sago Effluent on Seed Germination (SG),) and Seedling Dry Weight (SDW) Root Length, Shoot Length and Vigour Index

S. No	Effluent Concentration	*Phaselous mungo*				
		SG	SDW	Root Length	Shoot Length	Vigour Index
1	0	100	0.305	13.3	23.2	2320
2	2	85	0.325	12.7	22.4	1904
3	5	97	0.41	14.2	23.7	2298
4	10	70	0.31	13.6	23.1	1617
5	20	55	0.295	11.9	22.8	1254

Table 4: Effect of Sago Effluent on Seed Germination (SG), Seedling Dry Weight (SDW) Root Length, Shoot Length and Vigour Index

S. No	Effluent Concentration	*Cajanus cajan*				
		SG	SDW	Root Length	Shoot Length	Vigour Index
1	0	100	0.68	12.9	17.4	1740
2	2	80	0.59	13.3	16.9	1352
3	5	95	0.785	18.2	20.1	1905
4	10	70	0.59	16.2	18.6	1302
5	20	60	0.48	15.7	17.8	1068
6	30	30	0.38	15.3	16.9	507

Table 5: Effect of Sago Effluent on Seed Germination (SG), Seedling Dry Weight (SDW) Root Length, Shoot Length and Vigour Index

S. No	Effluent Concentration	*Phaselous aureus*				
		SG	SDW	Root Length	Shoot Length	Vigour Index
1	0	100	0.490	14.7	20.2	2020
2	2	78	0.475	13.2	21.7	1693
3	5	98	0.425	13.8	22.3	2185
4	10	75	0.315	12.5	21.3	1597
5	20	60	0.300	12.2	21.4	1284
6	30	35	0.300	11.8	20.8	624

RESULTS AND DISCUSSIONS

The physico-chemical characteristics of Sago industry wastewaters from *old* and *uptech* plants are presented in Tables 1&2. The data indicate that the sago liquid wastewater is acidic and organic in nature. The colour of the wastewater varies from light brown to thick brown colour with pungent odour. The wastewater is also turbid as it contains considerable amount of suspended solids. Both old and uptech sago industries effluents contained considerable concentrations of Nitrogen and phosphorous.

The pH of the old and uptech units ranged from 4.3- 6.5 indicating that the waste water is acidic in character. pH of the effluent (4.3) is significantly low in comparison to the maximum of 6.0 - 9.0 **(Brazil, 2002).**The acidity could be attributed to the presence of hydrogen cyanide in the cassava mill effluent and the acidity increased from root wash tank to combined waste water tank.

The total solids in the effluent progressively increased from root wash tank to secondary effluent tank in both the plants. The presence of starch granules may be responsible for higher levels of Total solids. Total Suspended Solids are high in both primary and secondary settling tanks compared to root wash tank in both the plants. (**Muoghaluand Omocho (2000)** have observed that TSS can absorb heat from the sun and transfer the same to the stream or water body thereby raising the temperature. TSS has the capacity to increase turbidity of waste water and depress light penetration into the water body. Total Dissolved solids were high in primary settling tank of both old and uptech plants.

In both old and uptech plants, the BOD increased from root wash tank to primary settling tank and then decreased in secondary settling tank. The combined waste waters of old and uptech plants recorded high BOD levels; 2700 ppm and 2000 ppm respectively. High BOD can lead to the production of ammonia and hydrogen sulphide (Boyd and Lichkopler, 1979). The COD levels in both old and uptech plants followed the similar trend that was observed in BOD. The combined waste waters of old and uptech plants also recorded high COD levels; 2800 ppm and 2700 ppm respectively. Alkalinity, total nitrogen, total PO_4 and hardness were also high in the waste waters of both old and uptech sago plants.

Seedling Growth: The results presented in Tables 3, 4 and5 indicate that the seedling growth of *Phaselous mungo, Cajanus cajan* and *Phaselous aureus* seeds from control (0%) to 30% of waste water from old industry. Seedling growth was maximum at control (0%) in all the three varieties and progressively reduced with increase in the concentration of waste water except at 5%.At 5% concentration the seedling growth in *Cajanus cajan*, *Phaselous mungo and Phaselous aureus* was 95, 97, and 98 percent respectively while at 30% the seedling growth was 30, 35, and 30 percent respectively.

Seedling Dry Weight (SDW): The results included in Tables 3, 4 and 5 indicate that the dry weight of the seedlings decreased with increase in the concentration of the effluent in *Phaselous aureus* while 2% effluent recorded more SDW (0.475gm) than 5% concentration .In the case of *Phaselous mungo* and *Cajanus cajan* the maximum SDW (0.41, 0.785gm respectively) was observed at 5% concentration of the effluent. Majority of the parameters have shown the negative response with increasing concentrations of SLW.Crops grown under controlled conditions with various industrial wastes have also shown similar trends (**AppalaRaju, 1985).**

Root and Shoot Lengths: The results presented in the Tables indicate that the three crops *Phaselous mungo, Cajanus cajan, Phaselous aureus* have showedprogressive decline both in root and shoot lenths with increase in effluent

concentration except in 5%.The data show that at 5% effluent concentrationboth root and shoot lenths of *Phaselous mungo, Cajanus cajan , Phaselous aureus* were 14.2,13.8,&18.2cm and 23.7, 20.1& 22.3 cm respectively.

Vigour Index: Data showing Tables 3,4 and5 indicate the vigour indexof three varieties and theVigour index was maximum in all the three crops at 5% concentration (2298,1905 and 2185) in *Phaselous mungo, Cajanus cajan, Phaselous aureus* andminimum at30% concentration (795,507 and 624).

CONCLUSIONS

The results of the present study indicate that 5 % of sago effluent has the potential to increase the seed germination, shoot and root length of seedlings and Vigour index compared to other concentrations. This may be attributed to the presence of considerable to good quantities of Nitrates and phosphates in the Sago effluent. Also the use of lower concentrations for Agricultural activity might have increased the potential of soil micro biota and there by soil stability. The study finally concludes that with further research, Sago effluent can be considered as a good media for Agricultural use and there by conserve the much needed water resources.

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